

# **Paul D. Nuñez**

Jet Propulsion Laboratory  
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# **Paul D. Nuñez**

NASA Postdoctoral Program Researcher  
Jet Propulsion Laboratory  
California Institute of Technology

## **EDUCATION**

- Ph.D. University of Utah  
Physics. 2012  
Thesis advisor: Stephan LeBohec
- B.S. Universidad de los Andes. Bogotá, Colombia  
Physics.

## **RESEARCH INTERESTS**

- High-angular-resolution astronomy: Resolving stellar surfaces and their close environments
- Data analysis techniques for astronomy and optics
- Numerical and experimental simulations of astronomical instruments
- Optical coherence and astrophysical quantum optics
- High energy astrophysics and gamma-ray astronomy

## **RESEARCH EXPERIENCE**

2014-Present **High-Resolution Astronomical Imaging** (NASA's Jet Propulsion Laboratory)

- Leading observations of circumstellar environments using Long-Baseline Optical Interferometry
- Searching for faint near-infrared emissions originating close the habitable-zone of main sequence stars
- Investigating the impact of exodiacial light on the detectability of exo-planets
- Improving data analysis techniques for optical interferometry

2012-2014 **Hypertelescopes** (Collège de France & Observatoire de la Côte d'Azur)

- Numerical and experimental simulations of Laser-Guide-Stars for Hypertelescopes
- Contribution to the construction and operation of a novel prototype interferometer
- Simulations of imaging capabilities of a multi-aperture large optical telescope
- Development of image deconvolution techniques

2007-2012 **Stellar Intensity Interferometry** (University of Utah)

- Simulations of air Cherenkov telescope arrays used for intensity interferometry.
- Development of image reconstruction techniques from simulated data
- Software development in C/C++ and Python

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- Experiments for measuring photon-photon correlations

2007-2012 **Gamma-Ray Astronomy** (University of Utah)

- Modeling of gamma-ray attenuation in high energy emitting binary systems
- Application of proposed model to the source  $LSI + 61^\circ 303$ .
- Development of data analysis techniques for improving background subtraction

2005-2007 **Astrophysics of Compact Objects** (Universidad de los Andes and U. Sergio Arboleda)

- Development of formalism to determine macroscopic properties of compact rotating objects from the measurement of the gravitational red-shift

2005-2007 **Small Satellite Program** (Universidad de los Andes and U. Sergio Arboleda)

- Development of the attitude control system for CubeSat *Libertad I*
- Construction of antenna deployment system

## **HONORS AND AWARDS**

2014 NASA Postdoctoral Program Fellowship

2013 Doblin Federation Conference Grant

2010 Third place for best presentation at the Intermountain Graduate Symposium

## **TEACHING EXPERIENCE**

2013 Optics laboratory teaching assistant. Université de Nice

2010-2012 Tutor for introductory and advanced physics. University of Utah

2012 Invited lecturer for applied mathematics summer school. University of Utah

2011 Invited lecturer for Computational physics course. University of Utah

2008 Invited lecturer for error analysis course. University of Utah

2007 Teaching assistant for introductory physics. University of Utah

2006 Theoretical physics for the Mathematics Department. Universidad Sergio Arboleda

2006 Introductory astronomy. Universidad Sergio Arboleda

2004-5 Teaching assistant for introductory physics. Universidad de los Andes

## **ASTRONOMICAL OBSERVING EXPERIENCE**

2014-2015 CHARA Interferometer (California, USA)

2012-2013 Ubaye Hypertelescope prototype (France)

2011 VERITAS/Whipple 10m gamma-ray experiments (Arizona, USA)

2006-7 Observatorio Astronómico, Universidad Sergio Arboleda (Bogotá, Colombia)

## **SYNERGISTIC ACTIVITIES**

2014 Proposed and organized a conference on intensity interferometry and quantum optics (Observatoire de la Côte d'Azur, France)

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- 2013 Organizer for the VLTI school (Very Large Telescope Interferometer). Visit to the Hypertelescope site (Barcellonette, France)
- 2012 Consultant for Boeing on Fourier imaging (Boeing-SVS, Albuquerque, New Mexico, USA)
- 2010 Participant in the International school on High Angular Resolution Techniques (Observatoire de Paris, France)
- 2010 Visiting scientist at Fabien Malbet's interferometry research group (Institut de Planétologie et d'Astrophysique de Grenoble (IPAG), Grenoble, France)
- 2009 Organizer of Stellar Intensity Interferometry workshop (University of Utah, USA)
- 2007 CubeSat (small satellites) developers workshop (Boeing facilities at Huntington Beach, USA)

## **SERVICE**

- 2011-2015 Referee. Monthly Notices of the Royal Astronomical Society
- 2014 Referee. Optical Society of America
- 2012-2013 Scientific advisor for Colombia's Pacific coast "Foundation for the development of science and technology" (FUPATECNO)
- 2010 Referee. Jr. Science & Humanities Symposium (IJSHS), USA

## **LANGUAGES**

Native proficiency in English and Spanish.  
Professional working proficiency in French

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## **PUBLICATIONS**

### **Refereed first author publications**

- 2015 Capabilities of future intensity interferometers for observing fast-rotating stars: imaging with two- and three-telescope correlations (P. D. Nuñez & A. Domiciano de Souza), in *Monthly Notices of the Royal Astronomical Society (MNRAS)*, volume 453, 2015
- 2014 Laser-Guide-Stars for Optical Interferometry: an application to the Hypertelescope (P. D. Nuñez, A. Labeyrie, P. Riaud), in *MNRAS*, volume 439, 2014
- 2012 Imaging submilliarcsecond stellar features with intensity interferometry using air Cherenkov telescope arrays (P. D. Nuñez, R. Holmes, D. Kieda, J. Rou, S. LeBohec), *MNRAS*, volume 424, 2012
- 2012 High angular resolution imaging with stellar intensity interferometry using air Cherenkov telescope arrays (P. D. Nuñez, R. Holmes, D. Kieda, S. LeBohec), *MNRAS*, volume 419, 2012
- 2011 Gamma-ray Attenuation in X-ray Binaries: An Application to LSI + 61°303 (P. D. Nuñez, S. LeBohec, S. Vincent), *Astrophysical Journal (ApJ)*, volume 731, 2011
- 2010 Extracting information from the gravitational redshift of compact rotating objects (P. D. Nuñez, M. Nowakowski), *Journal of Astrophysics and Astronomy (JOAA)*, volume 31, 2010

### **Refereed contributing author publications**

- 2015 Optical aperture synthesis with electronically connected telescopes (D. Dravins, T. Lagadec, P. D. Nuñez), *Nature Communications*, volume 6, 2015
- 2015 Long-baseline optical intensity interferometry. Laboratory demonstration of diffraction-limited imaging (D. Dravins, T. Lagadec, P. D. Nuñez), *Astronomy & Astrophysics*, volume 580, 2015
- 2013 Monte Carlo simulation of stellar intensity interferometry (J. Rou, P. D. Nuñez, D. Kieda, S. LeBohec), *MNRAS*, volume 788, 2013.
- 2012 Stellar intensity interferometry: Prospects for sub-milliarcsecond optical imaging (D. Dravins, S. LeBohec, H. Jensen, P.D. Nuñez), *New Astronomy Reviews (NAR)*, volume 56, 2012.
- 2012 Optical intensity interferometry with the Cherenkov Telescope Array (D. Dravins, S. LeBohec, H. Jensen, P. D. Nuñez), *Astroparticle Physics*, 2012
- 2012 The 2010 Very High Energy  $\gamma$ -Ray Flare and 10 Years of Multi-wavelength Observations of M87 (Abramowski et al.), *ApJ*, volume 746, 2012.
- 2012 VERITAS Observations of Day-scale Flaring of M 87 in 2010 April (VERITAS Collaboration, E. Aliu et al.), *In ApJ*, volume 746, 2012.
- 2011 Detection of Pulsed Gamma Rays Above 100 GeV from the Crab Pulsar (VERITAS Collaboration, E. Aliu et al.), *In Science*, volume 334, 2011.

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## **Non-refereed first author publications**

- 2014 The Hypertelescope Laser-Guide-Star (P. D. Nuñez & A. Labeyrie) *Improving the performance of optical interferometers and future designs. Conference proceedings*
- 2013 Laser-Guide-Stars for Hypertelescopes (P. D. Nuñez & A. Labeyrie) *Adaptive Optics for Extremely Large Telescopes III. Conference proceedings*, In Press
- 2012 Imaging hot stars with intensity interferometry using Cherenkov telescope arrays (P. D. Nuñez, S. Lebohec, D. Kieda, R. Holmes, J. Rou) *Astronomical Society of the Pacific conference series*, volume 464, 2012.
- 2010 Stellar intensity interferometry: imaging capabilities of air Cherenkov telescope arrays (P. D. Nuñez, S. Lebohec, D. Kieda, R. Holmes, H. Jensen, D. Dravins), *In Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, volume 7734, 2010.

## **Non-refereed contributing author publications**

- 2010 Two-dimensional image recovery in intensity interferometry using the Cauchy-Riemann relations (R. B. Holmes, S. Lebohec, P. D. Nuñez), *In Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, volume 7818, 2010.
- 2010 Stellar intensity interferometry: optimizing air Cherenkov telescope array layouts (H. Jensen, D. Dravins, S. Lebohec, P. D. Nuñez), *In Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, volume 7734, 2010.
- 2010 Stellar intensity interferometry: experimental steps toward long-baseline observations (S. Lebohec, B. Adams, I. Bond, S. Bradbury, D. Dravins, H. Jensen, D. B. Kieda, D. Kress, E. Munford, P. D. Nuñez, R. Price, E. Ribak, J. Rose, H. Simpson, J. Smith), *In Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, volume 7734, 2010.
- 2010 Stellar intensity interferometry: astrophysical targets for sub-milliarcssecond imaging (D. Dravins, H. Jensen, S. Lebohec, P. D. Nuñez), *In Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, volume 7734, 2010.
- 2010 Intensity Interferometry with Cherenkov Telescopes (D. B. Kieda, S. Lebohec, P. Nuñez), *In Revista Mexicana de Astronomia y Astrofisica Conference Series*, volume 38, 2010.
- 2009 New Astrophysical Opportunities Exploiting Spatio-Temporal Optical Correlations (C. Barbieri, M. K. Daniel, W. J. de Wit, D. Dravins, H. Jensen, P. Kervella, S. Le Bohec, F. Malbet, P. D. Nuñez, J. P. Ralston, E. N. Ribak), *In astro2010: The Astronomy and Astrophysics Decadal Survey*, volume 2010, 2009.
- 2009 Towards the Intensity Interferometry Stellar Imaging System (M. Daniel, W. J. de Wit, D. Dravins, D. Kieda, S. LeBohec, P. Nuñez, E. Ribak), *In ArXiv e-prints*, 2009.
- 2008 Toward a revival of stellar intensity interferometry (S. LeBohec, C. Barbieri, W.-J. de Wit, D. Dravins, P. Feautrier, C. Foellmi, A. Glindemann, J. Hall, J. Holder, R. Holmes, P. Kervella, D. Kieda, E. Le Coarer, S. Lipson, F. Malbet, S. Morel, P. D. Nuñez, A. Ofir, E. Ribak, S. Saha, M. Schoeller, B. Zhilyaev, H. Zinnecker), *In Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, volume 7013, 2008.

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### **Public outreach publications**

2012 The humanity of Physics (P. D. Nuñez) *Entremares Magazine*, volume 1, 2012.

2007 Las estrellas de neutrones: Trompos cósmicos (P. D. Nuñez), *Innovación y Ciencia*, volume XIV, No. 14, 2007.

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## **PRESENTATIONS**

### **Oral presentations:**

- 2015 Resolving the circumstellar environment near the habitable-zone of main sequence stars (P. D. Nuñez, B. Mennesson, T. ten Brummelaar, N. Scott) *Postdoc Seminar*. JPL, USA.
- 2015 Resolving stars and their environments with optical interferometry (P. D. Nuñez), *Physics Seminar*. Reed College, Oregon, USA
- 2014 Capabilities of Future Intensity Interferometers (P.D. Nuñez) *Workshop on Hanbury-Brown & Twiss Interferometry*. Nice, France
- 2013 Laser guide stars for hypertelescopes (P. D. Nuñez & A. Labeyrie) *Improving the performance of current optical interferometers and future designs*. Haute-Provence, France
- 2013 Feasibility and performance studies of adaptively phased hypertelescopes (P. D. Nuñez) *Journée du Collège de France*. Nice, France
- 2012 Towards intensity interferometry using Cherenkov telescope arrays (P. D. Nuñez) *Methods for Physical Observation seminar, Observatoire de la Côte d'Azur*. Nice, France
- 2012 Imaging hot stars with intensity interferometry using Cherenkov telescope arrays (P. D. Nuñez) *Circumstellar dynamics at high resolution conference*. Foz do Iguacu, Brazil
- 2012 Stellar Intensity Interferometry and high angular resolution imaging (P. D. Nuñez) *Seminar for Electrical Eng. and Physics depts. Cal Poly*. San Luis Obispo, California
- 2011 High angular resolution imaging with intensity interferometry (P. D. Nuñez) *Applied math seminar, Dept. of Mathematics, U of Utah..* Salt Lake city, Utah
- 2011 High angular resolution imaging with intensity interferometry using air Cherenkov telescope arrays (P. D. Nuñez) *Graduate student symposium, Dept. of Physics & Astronomy*. Salt Lake city, Utah
- 2011 High angular resolution astronomy with intensity interferometry (P. D. Nuñez) *Invited speaker for the Salt Lake astronomical society*. Salt Lake city, Utah
- 2010 Image reconstruction in intensity interferometry (P. D. Nuñez) *High angular resolution seminar, Université Joseph Fourier*. Grenoble, France
- 2010 Stellar intensity interferometry: imaging capabilities of air Cherenkov telescope arrays (P. D. Nuñez, S. Lebohec, D. ieda, R. Holmes, H. Jensen, D. Dravins), *In Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*. San Diego, California
- 2010 Intensity Interferometry with air Cherenkov telescope arrays (P. D. Nuñez) *Graduate student symposium, Utah state University*. Logan, Utah
- 2010 Stellar Intensity Interferometry with air Cherenkov telescope arrays (P. D. Nuñez) *Graduate student seminar. Dept. of Physics & Astronomy. U of Utah*. Salt Lake city, Utah

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- 2009 A new look on Intensity Interferometry (P. D. Nuñez, S. Le Bohec, D. Kieda, R. Holmes) *In APS April Meeting Abstracts*. Denver, Colorado
- 2009 Image recovery in intensity interferometry P. D. Nuñez) *Intensity Interferometry workshop, Dept. of Physics, U of Utah*. Salt Lake city, Utah
- 2007 The gravitational redshift of compact rotating objects *High energy astrophysics seminar, Dept of Physics, U of Utah*. Salt Lake city, Utah

### **Poster presentations**

- 2015 Resolving the circumstellar environment near the habitable zone of main-sequence stars (P.D. Nuñez, B. Mennesson, T. ten Brummelaar, N. Scott). *Postdoc Research Day*. JPL, USA
- 2013 Laser guide stars for hypertelescopes (P. D. Nuñez & A. Labeyrie) *Adaptive Optics for Extremely Large Telescopes*. Florence, Italy
- 2009 Intensity Interferometry with Air Cherenkov Telescope Arrays (P. D. Nuñez, S. LeBohec, D. Kieda, R. Holmes) *American Astronomical Society Meeting*. Pasadena, California